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ABSTRACT

This study investigated whether there were differences in science teachers' efficacy, perceptions of support and knowledge of developmentally appropriate curriculum and instruction in the two organizationally different settings of the junior high and the middle school. Teacher questionnaires were used as a source of data. From 127 returned questionnaires from teachers (a response rate of 79.4%) several conclusions were drawn. Among them were that: (1) the level of professional teaching efficacy was significantly higher for middle school science teachers than it was for junior high science teachers; (2) as compared to the junior high school teachers, science teachers in the middle schools had a greater understanding of the curriculum and instructional strategies that are most appropriate for adolescent students; (3) school organization, certification type, perceptions of support, and knowledge of developmentally appropriate curriculum and instruction are negligible predictors (5%) of personal efficacy; and (4) when type of school organization and type of certification are controlled for, knowledge of developmentally appropriate curriculum and instruction was the best predictor of professional science teaching efficacy for both middle and junior high school science teachers with secondary certification and for middle school science teachers with elementary certification. (PR)

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A Comparison of Middle and Junior High Science Teachers' Levels of Efficacy, and Knowledge of Developmentally Appropriate Curriculum and Instruction

by
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Presented at the Annual Meeting of the National Association for Research in Science Teaching, Atlanta, GA, April 1993

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Introduction

Within the last ten years several national reports, such as "A Nation at Risk" (National Commission on Excellence in Education, 1983), "Action for Excellence" (Education Commission of the States, 1983) and "Making the Grade" (Twentieth Century Fund Task Force, 1983), questioned the effectiveness of education in the United States. These reports unfavorably compared American schools to those of other countries, associating many nation-wide problems with the mediocrity of schools and teachers (Shor, 1986). More specifically, the low science scores of American students on competence and achievement tests raised questions concerning the present ability of educators to produce a scientifically literate society (Hazen & Trefil, 1991; Rutherford & Ahlgren, 1990). These researchers indicated that radical changes in the techniques and strategies used to teach science were needed to produce more effective teachers and teaching methods. One approach to this problem related the importance of teachers' belief about their effectiveness as a means of augmenting student achievement and successfully implementing educational reform.

Teacher Efficacy

Research examining teachers' attitudes about their abilities and effectiveness, by Midgley, Feldlaufer and Eccles (1989) emphasized that teachers' expectations and beliefs about their effectiveness influenced student motivation and achievement. Ashton and Webb (1986) concurred asserting that a relationship between the teachers' perception of their effectiveness and how they influence achievement was established, and that understanding these perceptions provided valuable insight into educational problems.

Early research by Bandura (1982) provided background and insight into the importance of one's belief in his or her effectiveness as a basis for determining behavior, thought and motivation. He pointed out that self-efficacy appeared to determine the goals and activities they chose and the amount and extent of the effort and preparation that preceded it. Additional research has applied his theory of self-efficacy directly to the educational environment (Ashton & Webb, 1986; Dembo & Gibson, 1985, Denham & Michael, 1981).

Dembo and Gibson (1985) defined efficacy in teaching, as "the extent to which teachers believe they can affect student learning" (p. 173). They measured the efficacy of teachers using two constructs comparable to those of Bandura's self-efficacy model. Their first construct, personal efficacy, was defined as the personal responsibility the teacher accepted for the student's learning or behavior. Their second construct, professional teaching efficacy, was explained as the belief that any teacher had the ability to overcome external factors such as home environment to affect student learning or

behavior. These researchers implied that despite inequalities, in these areas teachers believe all students can learn.

Additionally, research indicated that behavioral differences in teachers were related to teacher efficacy. These behaviors included classroom organization, instructional strategies, questioning techniques, teacher feedback to students, management of student on-task time, control tactics and a general sense of "withitness." (Ashton & Webb, 1986; Czerniak, 1989; Dembo & Gibson, 1985). This research supported the belief that for each of these types of behaviors highly efficacious teachers surpassed low efficacious teacher in their ability to direct student learning and manage the classroom.

According to Ashton & Webb (1986), behavioral differences in teachers were not the only areas that had a direct impact on the classroom. They identified important differences in teacher attitudes in relation to their behavior and beliefs with low-achieving students. The researchers summarized the attitudes of the low efficacy teachers as expecting low-achieving students to fail, expressing no surprise when their expectations came true, and taking no responsibility for the academic failures of their students. These teachers tended to be distrustful of the student and found security in the teacher as authority role. While in the same study, highly efficacious teachers viewed their low-achieving students as reachable and student problems as surmountable. They presumed it was their responsibility to help these students overcome their problems and took pride in their ability to teach these students. They believed that disruptive behavior could be avoided if teachers made clear and fair rules, enforced them consistently and established friendly relationships with students.

Further research concerning efficacy (Ashton & Webb, 1986; Dembo & Gibson, 1985; Rubeck & Enochs, 1991) indicted that levels of efficacy vary with the situation and the experience level of the teacher. Research by Ashton & Webb (1986) and Dembo & Gibson (1985) confirmed that personal teacher efficacy increased with years of teaching experience, while professional teaching efficacy decreased. In the same study, Dembo and Gibson stressed that while preservice teachers showed the least confidence in their skills, they had the highest professional teaching efficacy scores of all teachers, suggesting a strong idealistic belief that good teaching could overcome external factors. These researchers proposed that since professional teaching efficacy scores decreased with years of experience, something in the teaching experience worked against developing or maintaining a sense of efficacy. Dembo and Gibson (1985) stated that "We need to learn how beginning teachers can maintain their enthusiasm and commitment to teaching (p. 179)" and "how organizational factors increase or decrease the efficacy of participants in the organization (p. 180)."

School Organization

Several studies researched the importance of the interaction between teacher efficacy and school organization (Ashton & Webb, 1984; Blase, 1990; Denham & Michael, 1981; Fuller et al., 1982). Ashton (1984) emphasized conditions in the schools, such as isolation, the lack of collegial and administrative support, and the sense of powerlessness that comes from limited collegial decision-making, make it difficult for teachers to maintain a strong sense of efficacy.

Representing a different approach to the importance of school organization and teacher efficacy, Schmuck (1982) studied the organization of the school as it influenced student achievement and behavior. His research indicated that in schools where teachers were actively involved in decision-making and teamwork, students were more favorable to toward school. He further explained that the social competencies teachers gained in these activities produced a psychological context for effective interaction in the classroom.

In a study concerning the organizational affects of a middle and junior high school, Ashton and Webb (1986) found a marked difference in the teachers' sense of efficacy. In their study, the sense of community within schools contributed to the establishment and maintenance of efficacy. They determined that the organization, leadership, and ethos of middle schools bolstered the teachers' commitment to the profession by providing a greater sense of community and having a positive affect on teacher efficacy. In this study Ashton & Webb expressed the belief that educational reform was doomed to failure if the organizational structure of school was not addressed before trying to alter individual efficacy.

Fuller et al. (1982) also indicated that attempts to impose radical changes had negative effects on teacher efficacy and at the same time impeded the implementation of reforms and the final evaluation of its effectiveness. In addition, Poole, Okeafor and Sloan (1989) and Newmann et al., (1989) stressed that as the typical school organizational structures provided few incentives for teachers to implement change other than personal teacher satisfaction, the schools needed to develop means to reward, encourage and support innovation.

A study of the dissatisfaction of middle grade teachers, conducted by Midgley, et al. (1989), reported that teacher efficacy at this level was generally lower than that of elementary teachers. Similarly, Hurd (1981) associated the higher dissatisfaction among middle school teachers with the placement of teachers in the junior high who were trained for other levels of teaching.

Science Teaching and Efficacy

Further studies, related to the difficulties in obtaining and retaining qualified teachers in middle school and particularly in science, may be linked to teacher efficacy (Hurd, 1981; Blosser, 1983; NSTA, 1986; Rubeck & Enochs, 1991; Wright & Nassar, 1991; Greenbowe et al., 1992). In these studies, two statements of consensus have indicated that middle schools need to be recognized as a unique area in which to teach and that teachers need to be specially trained to teach science at this level.

A basic problem as identified by Blosser (1983) was that many educators in staffing middle schools consider that either elementary or secondary teachers can do the job. Furthermore with regards to science, she stated that neither the stereotypical content-oriented secondary science teacher s or the child-centered elementary teacher is prepared for middle school teaching.

Research has also related content background to variation in the level of teacher efficacy. Czerniak and Schriver (1991) noted that the lack of science content background was a common concern among low efficacious preservice elementary teachers. Likewise, research by Rubeck & Enochs (1991) indicated that personal efficacy was significantly lower in science areas where the teachers had little content background.

Also, research by Koballa and Crawley (1985) indicated that the low priority given to teaching science at the elementary level partially reflected the low value placed on science by the public and the educators who establish minimum requirements. The researchers in this study proposed that as science was not considered one of the "basics" for daily living by either the public or educators, students and teachers placed less emphasis on it Cunningham and Blankenship (1979) substantiated this low value placed on science teaching when they determined that preservice elementary teachers not only felt that their ability to teach science had no immediate effect on their success as interns but had no future effect on their success as teachers. This lack of support for science by both the public and educators would then weaken the professional efficacy of science teachers.

Purpose of Study

The purpose of this study was to determine whether there were differences in the science teachers' efficacy, perceptions of support and knowledge of developmentally appropriate curriculum and instruction in the two organizationally different settings of the junior high and middle school.

The study investigated six research questions. First, Is there a difference in the level of personal efficacy for science teachers in schools that have middle school programs and those in schools that have junior high programs? Second, Is there a difference in the level of professional efficacy for science teachers in schools that have middle school programs

and those in schools that have junior high programs? Third, Is there a difference in the knowledge of developmentally appropriate curriculum and instruction for science teachers in schools that have middle school programs and those in schools that have junior high programs? Forth, Is there a difference in the perceptions of support for science teachers in schools that have middle school programs and those in schools that have junior high programs Fifth, Is there a relationship among the level of personal efficacy, level of professional efficacy, the knowledge of developmentally appropriate curriculum and instruction, the teachers' perceptions of support, and whether the schools have middle or junior high programs? Sixth, Is there a relationship among the science teachers' level of personal efficacy, the level of professional efficacy, the knowledge of developmentally appropriate curriculum and instruction, the level of support and the type of certification?

Data Collection

This investigation involved three majors steps: school identification, a pilot study, and the main investigation. School identification was critical to this study since a wide variance exists among middle level schools. The issue is not resolved by relying on the building title, since some buildings labeled junior high schools had programs similar to buildings labeled middle schools. The researcher had to distinguish between these two organizational structures and randomly select 40 schools in each category for inclusion in the study. To this end a questionnaire was developed for school identification. A pilot study was used to assess the reliability of this questionnaire along with the teacher questionnaire. The teacher questionnaire was developed to assess perceptions of support and knowledge of developmentally appropriate curriculum and instruction. Having been used in the pilot study, these instruments were then used in the final study to assess type of school and perceptions of support and knowledge of developmentally appropriate curriculum and instruction, respectively. One additional questionnaire, which had previously been standardized, was used in the final study to measure teacher efficacy. This questionnaire, Science Teaching Efficacy Belief Instrument A (STEBI A), was developed by Riggs and Enochs (1990). The procedures used in adapting these questionnaires for this study and for determining their validity and reliability are discussed in greater detail in the following sections.

Pilot Study. As noted above, prior to the main study, a pilot study was conducted to test the reliability of the questionnaires. The sample from the pilot study consisted of seventh and eighth grade science teachers from eight middle schools and eight junior high schools in lower Michigan. The principals of the middle and junior high schools were contacted and a personal interview was arranged. At the interview the program questionnaire was completed and the teacher and efficacy questionnaires were given to

the principal or a science coordinator for distribution to the seventh and eighth grade science teachers. A date, approximately one week later, was established when the researcher would return for the completed materials. In total, 41 teachers participated in the pilot study. The reliability of each questionnaire was established from these data.

School Selection and Identification. The schools participating in the main study were randomly selected from all middle and junior high schools in Ohio using the 1991-1992 Ohio Educational Directory. The principals in these schools were contacted by phone and asked to respond to a survey concerning types of programs (See Appendix A). Principals were then asked to provide the names of two science teachers from their schools to participate in the study.

From the data obtained from the principals, schools were identified as middle or junior high schools. Schools identified as middle schools were required to have at least three of the following characteristics: grouping of students in clusters, houses, core groups or schools; interdisciplinary teaming of teachers; block, modular or other types of flexible scheduling; or a guidance program with scheduled interaction between teachers and students, such as an advisor-advisee program. Other traits used to classify the schools as middle schools were a curriculum containing at least three of the following areas: exploratory or enrichment programs for students; an intramural program in place of, or in addition to, an interscholastic sports programs; heterogeneous grouping of students; and a written curriculum for the development of social skills, decision making and problem solving, or values and attitudes.

Schools classified as junior highs were required to have at least three of the following characteristics: individualized scheduling of students with no grouping of students in clusters, houses, core groups or schools; departmentalization of teachers by subjects areas; scheduling of students in fixed periods; or a guidance program handled separately by the guidance counselor with no teacher involvement. In addition, to be classified as a junior high school had to have a curriculum with at least three of the following areas: fixed electives in place of exploratory programs for students; an interscholastic sports programs in place of an intramural program; homogeneous grouping of students; and no written curriculum for development of social skills, decision making and problem solving, or values and attitudes.

Collection of Data. To gather data for the main study, principals from the selected Ohio schools were asked to provide the name of one seventh and one eighth grade science teacher from their school to participate. These teachers were then mailed a cover letter explaining the research , a Teacher Questionnaire , and a Science Teaching Efficacy Belief Instrument . After the first mailing a total of 96 teachers returned questionnaires. 60% of the sample. After a three week interval elapsed, a follow-up letter and new questionnaires were sent, resulting in an additional response from 31 teachers.

Description of Sample

The subjects for the main study were obtained by using a stratified random sample of middle and junior high schools in the state of Ohio. Forty schools with middle school programs and 40 with junior high programs were selected for the study. From these schools 160 middle/junior high teachers teaching seventh or eighth grade science received questionnaires. A total of 127 teachers returned questionnaires, yielding a response rate of 79.4%. Responses from seven teachers were not used due to insufficient data, resulting in a final sample size of 120 or 75%.

The schools selected for the study were randomly chosen from all middle and junior high schools within the state of Ohio. In the sample, no attempt was made to provide an equal representation by gender, age, years of experience, certification, or major. However, it was important to determine whether any significant differences existed between the respondents from the middle and junior high schools. For the study, science teachers in grade seven and eight selected by their principals provided information concerning their total years of teaching experience and their years of teaching experience in the following areas: science, seventh or eighth grade, and in their present school. Information was also provided about the type of certification and major area of certification or concentration.

Instrumentation

This study was designed to examine three types of data in middle and junior high programs. As mentioned above, a questionnaire was developed to assess whether sampled schools implemented middle or junior high programs . Secondly, a questionnaire was developed to assess perceptions of support and knowledge of developmentally appropriate curriculum and teaching . Lastly, the Riggs and Enochs (1990) Science Teaching Efficacy Belief Instrument A was used to measure both personal science teaching efficacy and science teaching outcome expectancy or professional teaching efficacy .

Program Questionnaire. Items for the program questionnaire designed to determine type of school were adapted from research information concerning middle level education, as suggested by Alexander and George, 1981; Kindred et al., 1981; Wiles and Bondi, 1981; and Wiles and Bondi, 1986. Content validity for the instrument was obtained using the results of empirical data provided by principals during the pilot study. The results showed that the best indicators of schools with middle school programs were inclusion of house plans, block schedules, interdisciplinary teams and an advisor-advisee programs. The pilot study also revealed that four types of curricula were significant in

distinguishing between middle and junior high schools. Specifically, the types of curricula identified were: athletic programs (intramural or interscholastic), exploratory or enrichment programs, homogeneous or heterogeneous grouping of students, and written curricula addressing social skills.

Teacher Questionnaire. Similar to the process used for the development of the program questionnaire, the teacher questionnaire was designed from research on developmentally effective programs for adolescents (Alexander & George, 1981; Kindred et al., 1981; Wiles & Bondi, 1981; Wiles & Bondi, 1986) and teacher support (Ashton & Webb, 1986; Fuller et al., 1982). Input from three middle school experts was used to establish content validity for this instrument. A group of 15 graduate and undergraduate university students provided input on the clarity of phrasing of the items. This instrument was then used in the pilot study. It consisted of 46-items that were used to collect data concerning the demographics of the sample, the teachers' knowledge of developmentally appropriate curriculum and their perceptions of support. The reliability was .70 and was calculated using a split-half procedure.

Efficacy Questionnaire. To measure teacher efficacy the Science Teaching Efficacy Belief Instrument A, STEBI A (Riggs & Enochs, 1990) was used. This instrument consisted of 25 items in a Likert format. It included both a Personal Science Teaching Efficacy Belief Scale and a Science Teaching Outcome Expectancy Scale. The reliability was established with a reported coefficient alpha of .92 for personal efficacy and .77 for outcome expectancy (professional efficacy). This was substantiated in the pilot study where the coefficient alpha was .92 for personal efficacy and .81 for professional efficacy.

Data Analyses

The data from the questionnaires were analyzed using two statistical procedures. First, t-tests were used to determine whether there were significant differences between the middle and junior high science teachers' levels of personal and professional teaching efficacy, knowledge of developmentally appropriate curriculum and instruction and perceptions of support. Second, a multiple regression analysis was performed to ascertain if there was a relationship between the variables in the study and the degree to which each variable predicted the personal and professional teaching efficacy of the science teachers.

Results

Description of the Sample

The sample for the study included 160 middle and junior high science teachers in the state of Ohio. From these teachers a total of 127 participated in the study for a return rate of 79.4%. Seven of the questionnaires were not used due to insufficient data resulting in

a sample size of 120 or 75%. Specifically, 58 junior high teachers and 62 middle school teachers responded to the survey. From the middle schools, 33 seventh and 29 eighth grade teachers responded, while from the junior high schools 31 seventh and 27 eighth grade teachers responded. Within this sample, middle school teachers tended to be less experienced than junior high teachers.

Hypotheses Testing

Six hypotheses were examined in this study. Four hypotheses were analyzed using t-tests and two using regression analyses. An alpha level of .05 was used to determine the level of significance for the hypotheses.

Hypothesis 1. Hypothesis 1 stated that there is no difference in the level of personal efficacy for science teachers in schools that have middle school programs and those in schools that have junior high programs.

Data in Table 1 show the results of the statistical treatment comparing middle and junior high teachers mean scores on personal efficacy.

Table 1

Means, Standard Deviations, and t-Tests for Personal Efficacy

Group	Mean	SD	t	p
Junior High	55.29	5.86		
Middle School	55.85	5.72	-.53	.596

Note: * p<.05, 2-tailed, df=118

The p value as shown in Table 1 was not significant at the .05 level. Therefore the null hypothesis was accepted. There was no significant difference in the personal efficacy for the science teachers in junior high schools and those in middle schools.

Hypothesis 2. Hypothesis 2 stated that there is no difference in the level of professional teaching efficacy for science teachers in schools that have middle school programs and those in schools that have junior high programs.

Data in Table 2 present the results of the statistical treatment comparing middle and junior high teachers mean scores on professional efficacy.

Table 2

Means, Standard Deviations, and t-Tests for Professional Teaching Efficacy

Group	Mean	SD	t	p
Junior High	36.36	6.99		
Middle School	39.27	5.98	-.246	.015*

Note: * p,.05, 2-tailed, df-118

The p value as shown in Table 2 was significant at the .05 level. Therefore the null hypothesis was rejected. The professional teaching efficacy of science teachers in middle schools was significantly higher than that of the science teachers in junior high schools.

Hypothesis 3. Hypothesis 3 stated that there is no difference in the knowledge of developmentally appropriate curriculum and instruction for science teachers in schools that have middle school programs and those in schools that have junior high programs.

Data in Table 3 indicate the results of the statistical treatment comparing middle and junior high teachers mean scores on knowledge of developmentally appropriate curriculum and instruction.

Table 3

Means, Standard Deviations, and t-Tests for Knowledge of Developmentally Appropriate Curriculum and Instruction

Group	Mean	SD	t	p
Junior High	17.88	3.76		
Middle School	19.64	2.89	-2.90	.004*

Note: * p<.05, 2-tailed, df=118

The p value as shown in Table 3 was significant at the .05 level. Therefore the null hypothesis was rejected. The knowledge of developmentally appropriate curriculum and instruction for the science teachers in middle schools was significantly higher than that of those in junior high schools.

Hypothesis 4. Hypothesis 4 stated that there is no difference in perceptions of support for science teachers in schools that have middle school programs and those in schools that have junior high programs.

Data in Table 4 show the results of the statistical treatment comparing middle and junior high teachers mean scores on Perceptions of Support.

Table 4

Means, Standard Deviations, and t-Tests for Perceptions of Support

Group	Mean	SD	t	p
Junior High	55.12	8.56		
Middle School	56.97	7.24	-1.28	.203

Note: * p<.05, 2-tailed, df=118

The p value as shown in Table 4 was not significant at the .05 level. Therefore the null hypothesis was accepted. There was no significant difference in the perceptions of support for the science teachers in junior high schools and the science teachers in middle schools.

Hypothesis 5. Hypothesis 5 stated that there is no relationship among the level of personal efficacy, level of professional efficacy, the knowledge of developmentally appropriate curriculum and instruction, the teachers' perceptions of support, and whether the schools have middle or junior high programs.

Data in Table 5 show the results of the statistical treatments of personal efficacy for the knowledge of developmentally appropriate curriculum and instruction, the teachers' perceptions of support, and school type.

Table 5

Summary of the Regression Analysis for Personal Efficacy with Knowledge, Support, and School Type.

	R	R sq.	F	Sig. F	df
	.213	.045	1.83	.145	116

Predictors	B	beta	T	Sig T
Knowledge	.150	.090	.946	.346
Support	-.130	.179	1.945	.054
School Type	-.056	-.005	-.051	.959

Note: * p<.05

The first dependent variable selected for regression analysis was personal efficacy. The regression model was constructed forcing the variables of school type, knowledge of developmentally appropriate curriculum and instruction, and perceptions of support into the equation. As shown in Table 5 these variables accounted for an R square of .045, or 5% of the variance in personal efficacy. The F value was not significant at the .05 level. Therefore, no relationship existed between personal efficacy and this model with the predictor variables of school type, knowledge, and support. None of the predictor variables contributed significantly to the regression equation at the .05 level.

Data in Table 6 indicate the results of the statistical treatments of professional teaching efficacy for the knowledge of developmentally appropriate curriculum and instruction, the teachers' perceptions of support, and school type.

Table 6

Summary of the Regression Analysis for Professional Teaching Efficacy with Knowledge, Support and School Type.

	R	R sq.	F	Sig. F	df
	.515	.265	13.97	.0000	116

Predictors	B	beta	T	Sig T
Knowledge	.935	.485	5.849	.0000*
Support	-.047	-.056	-.698	.486
School Type	-1.347	-.102	-1.235	.219

Note: *p<.05

The second dependent variable selected for regression analysis was professional teaching efficacy. The regression model was constructed forcing the variables of school type, knowledge of developmentally appropriate curriculum and instruction, and perceptions of support into the equation. As shown in Table 6 these variables accounted for an R square of .265 or 26% of the variance in professional teaching efficacy. The F value was significant at the .0000 level. Therefore, there was a relationship between professional teaching efficacy and the predictor variables of school type, knowledge, and support. Knowledge was the only predictor variable in this model that was a significant contributor to the regression equation at the .05 level (p=.000).

Hypothesis 6. Hypothesis 6 stated there is no relationship among the science teachers' level of personal efficacy, the level of professional efficacy, the knowledge of developmentally appropriate curriculum and instruction, the level of support and the type of certification.

Data in Table 7 present the results of the statistical treatment of the first model used for personal efficacy with certification, knowledge, support and school type.

Table 7

Summary of the Regression Analysis for Personal Efficacy with Certification, Knowledge, Support, and School Type

	R	R sq.	F	Sig. F	df
	.217	.047	1.409	.235	114

Predictors	B	beta	T	Sig T
Certification	.266	-.045	-.472	.638
Knowledge	.136	.081	.833	.406
Support	.132	.181	1.951	.054
School Type	.009	.167	.009	.993

Note : * p<.05

In the first model for personal efficacy the variables certification, school type, knowledge of developmentally appropriate curriculum and instruction, and perceptions of support were forced into the equation. As shown in Table 7 these variables accounted for an R square of .047, or 4.7% of the variance in personal efficacy. The F value was not significant at the .05. Therefore, no relationship existed between personal efficacy and this model with predictor variables of certification, school type, knowledge, and support. None of the predictor variables contributed significantly to the regression equation at the .05 level.

Data in Table 8 show the results of the statistical treatment of personal efficacy for junior high teachers with secondary certification.

Table 8

Summary of the Regression Analysis for Personal Efficacy with Knowledge, and Support, for Junior High Teachers with Secondary Certification

	R	R sq.	F	Sig. F	df
	.343	.118	2.34	.111	35
Predictors	B	beta	T	Sig T	
Knowledge	.600	.335	2.010	.052	
Support	.015	.023	.140	.889	

Note: * p<.05

The second model for personal efficacy selected only teachers with secondary certification in junior high schools and forced the variables knowledge of developmentally appropriate curriculum and instruction, and perceptions of support into the equation. As shown in Table 8 these variables accounted for an R square of .118, or 12% of the variance in personal efficacy. The F value was not significant at the .05 level. Therefore, no relationship existed for junior high teachers with secondary certification in this model for personal efficacy and with predictor variables of knowledge and support. None of the predictor variables contributed significantly to the regression equation at the .05 level.

Data in Table 9 show the results of the statistical treatment of personal efficacy for middle school teachers with elementary certification.

Table 9

Summary of the Regression Analysis for Personal Efficacy with Knowledge and Support for Middle School Teachers with Elementary Certification

	R	R sq.	F	Sig. F	df
	.278	.078	.840	.446f	20
Predictor	B	beta	T		Sig T
Knowledge	-.568	-.273	-1.272		.218
Support	-.046	-.062	-.289		.776

Note: * p<.05

In the third model for personal efficacy only teachers with elementary certification in middle schools were selected and the variables knowledge of developmentally appropriate curriculum and instruction, and perceptions of support were forced into the equation. As shown in Table 9 these variables accounted for an R square of .078, or only 7.8% of the variance in personal efficacy. The F value was not significant at the .05 level. Therefore, no relationship existed for middle school teachers with elementary certification between the personal efficacy and the predictor variables of knowledge and support. None of the predictor variables contributed significantly to the regression equation at the .05 level.

Data in Table 10 indicate the results of the statistical treatment of personal efficacy for middle school teachers with secondary certification.

Table 10

Summary of the Regression Analysis for Personal Efficacy with Knowledge and Support for Middle Schools with Secondary Certification

	R	R sq.	F	Sig. F	df
	.436	.190	3.049	.065	26
Predictors	B	beta	T		Sig T
Knowledge	-.159	-.076	-.397		.695
Support	.514	.458	2.408		.023

Note: * p<.05

The fourth and final model for personal efficacy selected only teachers with secondary certification in middle schools and forced the knowledge of developmentally appropriate curriculum and instruction, and perceptions of support into the equation. As shown in Table 10 these variables accounted for an R square of .190, or 19% of the variance in personal efficacy. The F value was not significant at the .05 level. Therefore,

there was no relationship between personal efficacy and model for the predictor variables of knowledge and support for middle school teachers with secondary certification. Support was the only predictor variable that was significant contributor to the regression equation at less than .05 level (p=.023).

No other types of certification were included in the models for the dependent variable personal efficacy because of insufficient sample size.

The second dependent variable selected for regression analysis was professional teaching efficacy. Data in Table 11 present the results of the statistical treatment of professional teaching efficacy with predictor variables of certification, knowledge, support and school type.

Table 11

Summary of the Regression Analysis for Professional Teaching Efficacy with Certification, Knowledge, Support, and School Type

	R	R sq.	F	Sig. F	df
	.515	.266	10.304	.0000*	114
Predictors	B	beta	T	Sig T	
Certification	.134	.020	.236	.814	
Knowledge	.944	.491	5.769	.0000*	
Support	-.047	-.057	-.699	.486	
School Type	-1.311	-.099	-1.177	.242	

Note: * p<.05

In the first model the variables certification, school type, knowledge of developmentally appropriate curriculum and instruction, and perceptions of support were forced into the equation. As shown in Table 11 these variables accounted for an R square of .266, or 27% of the variance in professional teaching efficacy. The F value was significant at the .05 level. Therefore, there was a relationship between professional teaching efficacy and this model with the predictor variables of certification, school type, knowledge, and support. Knowledge was the only predictor variable that was a significant contributor to the regression equation at the .05 level (p=.0000). However this model did not account for any more of the variance in professional teaching efficacy than the model in which certification was left out of the equation.

Data in Table 12 show the results of the statistical treatment of professional teaching efficacy for junior high teachers with secondary certification.

Table 12

Summary of the Regression Analysis for Professional Teaching Efficacy with Knowledge and Support for Junior High Teachers with Secondary Certification

	R	R sq.	F	Sig. F	df
	.387	.150	3.076	.059	35

Predictors	B	beta	T	Sig T
Knowledge	.743	.388	2.365	.024*
Support	-.002	-.002	-.018	.986

Note: * p<.05

The second model for professional teaching efficacy selected only teachers with secondary certification in junior high schools and forced the following variables into the equation: knowledge of developmentally appropriate curriculum and instruction, and perceptions of support. As shown in Table 12 these variables accounted for an R square of .150, or 15% of the variance in professional teaching efficacy. The F value was not significant at the .05 level. Therefore, there was no relationship between professional teaching efficacy and this model with the predictor variables of knowledge, and support for junior high teachers with secondary certification. Knowledge was the only predictor variable that was a significant contributor to the regression equation at the .05 level (p=.024).

Data in Table 13 indicate the results of the statistical treatment of professional teaching efficacy for middle school teachers with elementary certification.

Table 13

A Summary of Regression Analysis for Professional Teaching Efficacy with Knowledge and Support for Middle School Teachers with Elementary Certification

	R	R sq.	F	Sig. F	df
	.450	.202	2.535	.104	20

Predictors	B	beta	T	Sig T
Knowledge	.871	.450	2.252	.036*
Support	.012	.018	.091	.929

In the third model for professional teaching efficacy only teachers with elementary certification in middle schools were selected and the variables, knowledge of developmentally appropriate curriculum and instruction, and perceptions of support, were forced into the equation. As shown in Table 13 these variables accounted for an R square

of .202, or 20% of the variance in professional teaching efficacy. The F value was not significant at the .05 level Therefore, there was no relationship between professional teaching efficacy and this model with the predictor variables of knowledge and support for middle school teachers with elementary certification. Knowledge was the only predictor variable that was a significant contributor to the regression equation at the .05 level (p=.036).

Data in Table 14 present the results of the statistical treatment of professional teaching efficacy for middle school teachers with secondary certification.

Table 14

Summary of the Regression Analysis for Professional Teaching Efficacy with Knowledge and Support for Middle School Teachers with Secondary Certification

	R	R sq.	F	Sig. F	df
	.574	.330	6.401	.005	26
Predictors	B	beta	T	Sig T	
Knowledge	1.340	.594	3.430	.002*	
Support	-.071	-.059	-.341	.736	

Note: * p<.05

The fourth and final model for professional teaching efficacy selected only teachers with secondary certification in middle schools and forced the following variables into the equation: knowledge of developmentally appropriate curriculum and instruction, and perceptions of support. As shown in Table 14 these variables accounted for an R square of .330, or 33% of the variance in professional teaching efficacy. The F value of 6.401 was significant at the .05 level. Therefore, there was a relationship between professional teaching efficacy and the predictor variables of knowledge, and support for middle school teachers with secondary certification. Knowledge was the only variable that was a significant contributor to the regression equation at the .05 level (p=.002).

No other types of certification were included in the models for the dependent variable professional teaching efficacy because of insufficient sample size.

Summary

A total of six hypotheses were tested in this study. The analyses of the t-tests and regression equations led to five significant conclusions concerning personal and professional teaching efficacy.

--The level of professional teaching efficacy was significantly higher for middle school science teachers than it was for junior high science teachers. The middle school

teachers had a stronger belief that despite external factors teachers could make a difference in student learning.

--The knowledge of developmentally appropriate curriculum and instruction was significantly higher for middle school science teachers than for junior high science teachers. Science teachers in the middle schools had a greater understanding of the curriculum and instructional strategies that are most appropriate for adolescent students.

--School organization, certification type, perceptions of support, and knowledge of developmentally appropriate curriculum and instruction are negligible predictors (5%) of personal efficacy.

--When school organization, certification type, perceptions of support, and knowledge of developmentally appropriate curriculum and instruction are forced into the regression equation 26% of the variance in professional science teaching efficacy can be explained, with the best predictor, knowledge of developmentally appropriate curriculum and instruction accounting for 25% of this variance.

--When type of school organization and type of certification were controlled for, knowledge of developmentally appropriate curriculum and instruction was the best predicator of professional science teaching efficacy for both middle and junior high science teachers with secondary certification and for middle school science teachers with elementary certification. The sample size was insufficient for analysis of junior high science teachers with elementary certification.

Conclusions and Discussion

The results of this study and the conclusions reached appeared to provide some answers to questions raised by other researchers concerned with the levels of personal and professional teaching efficacy toward the teaching of science in the middle grades. In addition, this study seemed to provide some background into variables that may influence the levels of personal and professional teacher efficacy for middle level science teachers.

The data examined in this study revealed that there was no significant difference in either the levels of personal efficacy or the perceptions of support when comparing middle and junior high science teachers. Although the middle school science teachers had higher perceptions of support than junior high teachers, this difference was not significant at the .05 level.

The data analyzed concerning personal efficacy revealed that there was no significant difference in the personal efficacy scores in the two organizationally different settings. This data would appear to concur with findings of Ashton & Webb (1986) in which middle school teachers, while not significantly different statistically, had higher mean scores on personal efficacy.

When professional teaching efficacy was examined, the data from this study showed that middle school teachers were significantly higher than junior high teachers in their level of professional teaching efficacy and knowledge of developmentally appropriate curriculum and instruction. This higher level of professional efficacy for teachers with less experience was consistent with research by Dembo & Gibson (1985).

The significantly higher knowledge of the middle school teachers would appear to indicate that at least a portion of this knowledge was obtained through experience with these programs in the schools. Since the organizational structure of the middle schools was defined in this study as one in which more of these types of programs are being implemented, a stronger knowledge of these programs would be expected.

There was a strong relationship between the professional efficacy of teachers and their knowledge of developmentally appropriate curriculum and instruction. Knowledge proved to be a significant predictor of professional efficacy. This relationship was also significant when teachers were considered within each type of school setting. This relationship appeared to support the research indicating that teachers need to have specific knowledge of factors related to teaching science at the middle school level (Blosser, 1983; Greenbowe et al., 1992; Hurd, 1981; NSTA, 1986; and Wright & Nassar, 1991). These data would tend to affirm the popular belief that obtaining a knowledge of appropriate types of curriculum and instructional strategies that apply specifically for this age level may enhance and maintain teachers' perceptions of professional effectiveness.

Next, when certification was examined in relationship to both personal and professional teaching efficacy, it was shown that this factor had little or no effect on the efficacy of teachers. Furthermore, there appeared to be no indication, according to their type of certification, that either group of teachers received training specific to this grade level. However, the very nature of their certification (K-8 or 7-12) implied some training for this level of teaching.

In summary, this study clearly showed that for middle school teachers the level of support they received appeared to affect the level of personal efficacy. Knowledge of developmentally appropriate curriculum and instruction was shown to have a strong relationship with professional teaching efficacy.

Implications

This study revealed several outcomes that offer implications for science education, teacher education institutions and for providing inservice to middle level teachers. Initially, this study lends support to the literature that suggests that teaching science at the middle school level is facilitated by a knowledge base that is specific to the needs of adolescents. Therefore, this study suggests the need for science teachers in middle level education to have specific knowledge of students, curriculum and instructional methods.

This finding may prove valuable to teacher education institutions as they prepare teachers for work at the middle grades level. Moreover, the results support advocates who stress that specific training should be necessary for these teachers as it is for elementary and secondary teachers. Therefore, it appears that teacher preparation programs that are focused on preparing middle school teachers who have a greater knowledge of adolescents and appropriate curriculum and instructional methods should increase the professional efficacy of those teachers. Lastly, the positive relationship between professional teaching efficacy and knowledge of developmentally appropriate curriculum and instruction suggests possible approaches to the problem of declining professional efficacy that occurs as teachers become more experienced. This research would suggest the need for programs designed specifically to address the problem of declining professional efficacy. According to the results of this research, inservice programs which provide middle school teachers with strategies and experiences for implementing curriculum designed for adolescents should be effective in enhancing and maintaining the efficacy of experienced teachers. Therefore, within the limitations of this study, the findings indicate that education specific to the developmental needs of middle level students is warranted and crucial for both preservice and inservice teachers.

Recommendations for Further Research

A careful analysis of this study indicated that several areas need further investigation. As with all new knowledge, research requires replication prior to being accepted. Of prime consideration in this study was the sample used. Because this study included only seventh and eighth grade science teachers in the state of Ohio, it would seem wise and prudent to replicate this study in other states to determine whether the results are consistent with this study. Since this study included a small sample of teachers beginning their teaching careers and no teachers with just middle school certification, replicating this study with another sample of teachers, which controls for experience level and type of certification, seems appropriate.

As reliability and validity assessment is a continuing process, further research should enhance the ability of the instruments to accurately measure each construct. Future studies should include reliability assessment for each population used and efforts should be made to further validate the instruments.

It seems advantageous to have future research focus on the relationships between personal and professional efficacy and other variables. Although support did not prove to be a major factor in this study, the inconsistency of findings in this study and with other research would indicate that this area should be investigated further. Examining the effects of support from a variety of sources within education, such as colleagues, administrators, and parents, may prove beneficial.

Also the strong relationship established in this research between professional teaching efficacy and knowledge of developmentally appropriate curriculum and instruction would indicate several areas which it may be advantageous to investigate. Research into the influence of years of teaching experience as part of the relationship between professional teaching efficacy and knowledge of developmentally appropriate curriculum may provide additional insight.

In this study, the knowledge of developmentally appropriate curriculum and instruction pertained to middle level education in general. Therefore, it may be advantageous to examine the effects of knowledge specific to the teaching of science.

Finally, the part that knowledge of developmentally appropriate curriculum and instruction plays in the teachers' level of efficacy remains a concern, as it may not be restricted to science but to teaching at this level in general. Therefore, further research should consider whether this knowledge is related to actual implementation of developmentally appropriate curriculum and instructional strategies throughout middle level education.

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